SCM–1 SCA FREQUENCY AND MODULATION MONITOR

Belar Electronics Laboratory, Inc.
P.O. Box 826
Lancaster Avenue at Dorset
Devon, Pennsylvania 19333

SPECIFICATIONS

Modulation Meter Range ..... 133% to —70 db
SCA Modulation Sensitivities ..... 100% = 6 kHz, 4 kHz 2 kHz switched
Maximum Modulation Frequency ... 5 kHz at 6 kHz Deviation
SCA Modulation Calibrator ..... 2 kHz
SCA Subcarrier ..... 24 kHz to 74 kHz, 4 switched crystal positions. SCA subcarrier and deviation maintained in the FCC allowable total frequency deviation
SCA Injection level ..... 133% to 5%
SCA Peak Indicator .....100% = 6 kHz, 4 kHz, 2 kHz switched, independent of modulation polarity
SCA Frequency Meter ..... 2 kHz
Internal Crosstalk
Sub to Main ..... —66 db
Main to Sub ..... better than 50 db
Stereo to Sub ..... better than 50 db
Remote Metering .....Both frequency meter and modulation meter may be remotely metered, 5000 ohms external loop resistance
Size .....5¼" H x 19" W x 10½" D

UNPACKING

When unpacking the SCM—1, avoid damaging the equipment through use of careless procedures. Inspect all equipment for physical damage immediately after unpacking. If damage exists, file a claim with the transportation company and advise Belar of such action. Save all packing material for proof of damage claim.

INSTALLATION

The SCM—1 SCA Frequency and Modulation Monitor is designed to be mounted in a standard 19-inch rack mount. When mounted in a rack, no cooling area need be provided above or below the unit as very little heat is generated by the monitor. When the monitor is mounted above high heat generation equipment such as vacuum-tube power supplies, consideration should be given to cooling requirements which allow a free movement of cooler air through and around the SCM—1. In no instance should the ambient chassis temperature be allowed to rise above 50 degrees C [122 degrees F]. Mount the SCM—1 to the rack mount panel using four No. 10 countersunk finishing washers.

GENERAL DESCRIPTION

The SCM—1 has been designed to meet FCC requirements for measuring the SCA center frequency and SCA modulation characteristics of SCA multiplexed FM transmitters having an SCA center frequency range of 24 to 74 kHz. In addition, the SCM—1 may be used as a low distortion and low noise SCA demodulator for driving audio monitors. The SCM—1 is to be used in conjunction with the FMM—1.

The SCM—1 is completely solid state utilizing all silicon transistors for long, trouble-free life. The individual circuits are constructed on two military grade, glass-epoxy, printed circuit boards. High reliability industrial and military grade components are used throughout.

The SCM—1 is constructed on a standard 5¼ x 19 inch rack mount. Seldom used controls and test points are located under the hinged name-plate cover. Factory adjustments are located within the shielded compartment of the monitor. The AC power input, baseband input, and monitor output are located on the rear of the SCM—1 chassis on individual connectors or on rear terminal blocks.

ELECTRICAL DESCRIPTION

The SCM—1 is a solid state crystal controlled, superheterodyne, SCA adaptor incorporating a 260 kHz IF strip and a stable, broadband frequency discriminator that measures the SCA center frequency deviation and demodulates the SCA subcarrier. Four switched crystal positions are available to measure and monitor up to four subcarriers, one at a time. Various metering and testing provisions are contained within the SCM—1 to measure transmitter output characteristics. These provisions include an SCA center frequency deviation meter; a peak reading modulation meter; a peak modulation light independent of SCA modulation polarity that responds to both positive and negative directions; a modulation calibrator to accurately set the SCA modulation meter calibration; a sensitive average voltmeter circuit for injection level, crosstalk, and noise measurements; and metering circuits to standardize the SCM—1 with the FMM—1. Remote monitoring of the SCM—1 may be externally provided for the SCA center frequency deviation meter, modulation meter, and peak modulation light.

EXTERNAL CONNECTIONS

Plug the line cord into a nominal 117 volts 60 Hz source. Connect an 18 inch coaxial cable [supplied] between J1 on SCM–1 to J2 on FMM–1. Connect an 18 inch coaxial cable [supplied] between J2 on SCM–1 to J6 on FMM–1. Connect 18 inch coaxial cable [supplied] between J3 on SCM–1 to J5 on FMM–1. These last two are for AM noise and incidental AM measurements.

If desired, connect external aural monitoring amplifier to terminals 1 and 2 on TB2. Note that this is an unbalanced output with terminal 1 grounded. A remote center frequency deviation meter and remote modulation meter may be connected to terminals, 5, 6 and 3, 4 respectively, if desired. Observe the proper polarities and note that the external loop resistance not including meters must be 5000 ohms. These meters must be obtained from Belar Electronics Laboratory, Inc. in order to comply with the regulations of remote metering. A remote peak modulation lamp may be connected to terminals 9 and 10. Do not short terminal 9 to ground. Audio tests may be made at the audio test jack on the front panel.

OPERATION

1. Before turning unit on, depress FREQ CAL switch, the REMOTE METER switch to off [released], and the TOTAL MOD switch to on [depressed].

2. Place FMM–1 into operation, with the AMP BAL switch depressed.

3. Depress the POWER switch PWR to on [depressed] and allow a 15-minute warm-up. Turn RANGE switch to MOD.

4. Adjust FREQ ZERO potentiometer to zero deviation meter and adjust MOD ZERO potentiometer to zero modulation meter.

5. Depress MOD CAL switch on FMM–1 and adjust R1 on the rear panel of the SCM–1 chassis so that the SCM–1 modulation meter reads 100%. This adjustment will be necessary only during initial set-up or installation. This adjustment standardizes the SCM–1 with the FMM–1.

6. Place the FMM–1 into the operate OP position.

7. Depress the MOD CAL switch to on [depressed] and the DEV switch to 2 kHz [depressed]. Adjust MOD CAL to read 100%. Note: The MOD CAL rolls off the frequency response and must not be depressed when measuring total modulation or main modulation.

8. The SCM–1 is now calibrated and may be placed into operation by depressing the desired FREQ position. When the SCM is supplied with only one crystal, it will normally be on position 3.

9. Total modulation is measured with the TOTAL MOD switch depressed. The MOD CAL switch on the SCM–1 must not be depressed for it rolls off the frequency response.

10. Main channel is measured with the MAIN MOD switch depressed. Crosstalk measurements from SCA to main channel may be made with no modulation on the main channel and the RANGE switch turned to a more sensitive position [0–50 db]. The crosstalk reading is the sum of the meter reading and range reading, i.e., – 12 db on meter and – 50 db on range yields – 62 db. The MOD CAL switch must not be depressed on the SCM–1 for it rolls off the frequency response.

11. Subcarrier injection level may be measured with the SUB INJ switch depressed. The RANGE switch may be set to the desired range: 10%, 30% or 100% and the corresponding meter scale is used.

12. For SCA modulation, the DEV switch is depressed for the desired range, i.e., 6, 4, or 2 kHz deviation and the calibration is changed accordingly. With RANGE switch in MOD, the 100% meter reading corresponds to 6, 4 or 2 kHz deviation according to the above setting. When switched to the sensitive positions, say – 50 db, then the range is 50 – db below the 6, 4, or 2 kHz deviation. This is to say the SCA modulation measurements are normalized to the deviation setting.

13. The peak indicator [PEAK MOD] lamp may be set with the PERCENT MOD potentiometer to the desired level. 100% corresponds to the setting of the

DEV switch and may be 6, 4, or 2 kHz deviation.

FUNCTIONS

1. FREQ ZERO Potentiometer — Zeroes the frequency deviation meter in the FREQ CAL position.

2. POWER switch — Turns the unit on.

3. FREQUENCY 1, 2, 3, 4 switch — Selects one of the four crystal positions to heterodyne the SCA subcarrier frequency up to the 260 kHz IF frequency.

4. FREQ CAL switch — Selects the 260 kHz calibrating crystal for frequency calibration.

5. MOD CAL switch — Activates the 258 kHz and 262 kHz calibrating oscillators and the chopper to develop the 4 kHz peak-to-peak modulation deviation. Also inserts de-emphasis in the voltmeter circuits to remove the overshoot in the calibrating waveform.

6. AUDIO TEST jack — Tests output from the monitoring amplifier. Permits linearity tests, frequency response tests, and FM noise tests to be made from the front panel, with de-emphasis in.

7. TOTAL MOD switch — Measures total negative modulation of baseband signal.

8. MAIN MOD switch — Inserts 15 kHz low pass filter to measure main modulation.

9. SUB INJ switch — Measures subcarrier injection when FREQ switch is in an active position.

10. DEVIATION, 6, 4, 2 switch — Selects one of three SCA deviation ranges. Modulation meter and peak indicator lamp are normalized to this 6 kHz, 4 kHz, or 2 kHz deviation.

11. AM NOISE switch — Measures AM noise of FM carrier.

12. INC AM switch — Measures incidental AM noise of FM carrier.

13. REMOTE METER switch — When in the off position [released] removes remote meters from the monitor circuits and substitutes their equivalent resistances.

14. MOD CAL potentiometer — Sets level into discriminator to 100% when DEV switch is in 2 kHZ position.

15. MOD ZERO potentiometer — Zeroes modulation meter with no signal and RANGE switch in MOD position.

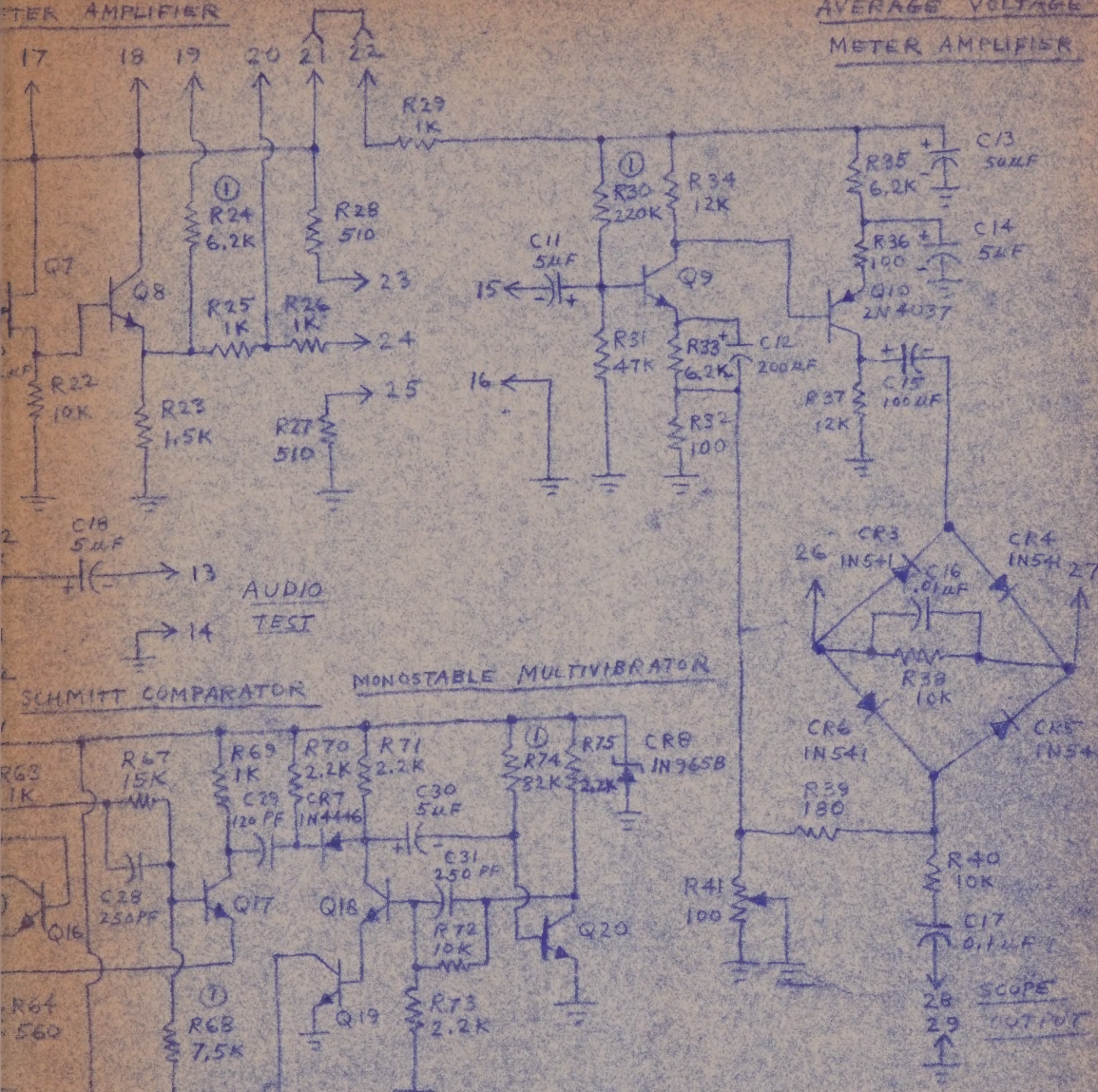
16. PERCENT MODULATION potentiometer — Pre-sets the peak modulation lamp to flash at the indicated modulation setting. This circuit is independent of modulation polarity and can be activated by either a positive or negative modulation peak.

17. RANGE switch — MOD — Measures the percentage of modulation with the peak reading voltmeter.

18. RANGE switch — 0 to 50 db — Measures crosstalk, noise and modulation with the average reading voltmeter.

TER AMPLIFIER

AVERAGE VOLTAGE METER AMPLIFIER



REVISIONS		
NO.	DATE	BY
1		
2		
3		
4		
5		

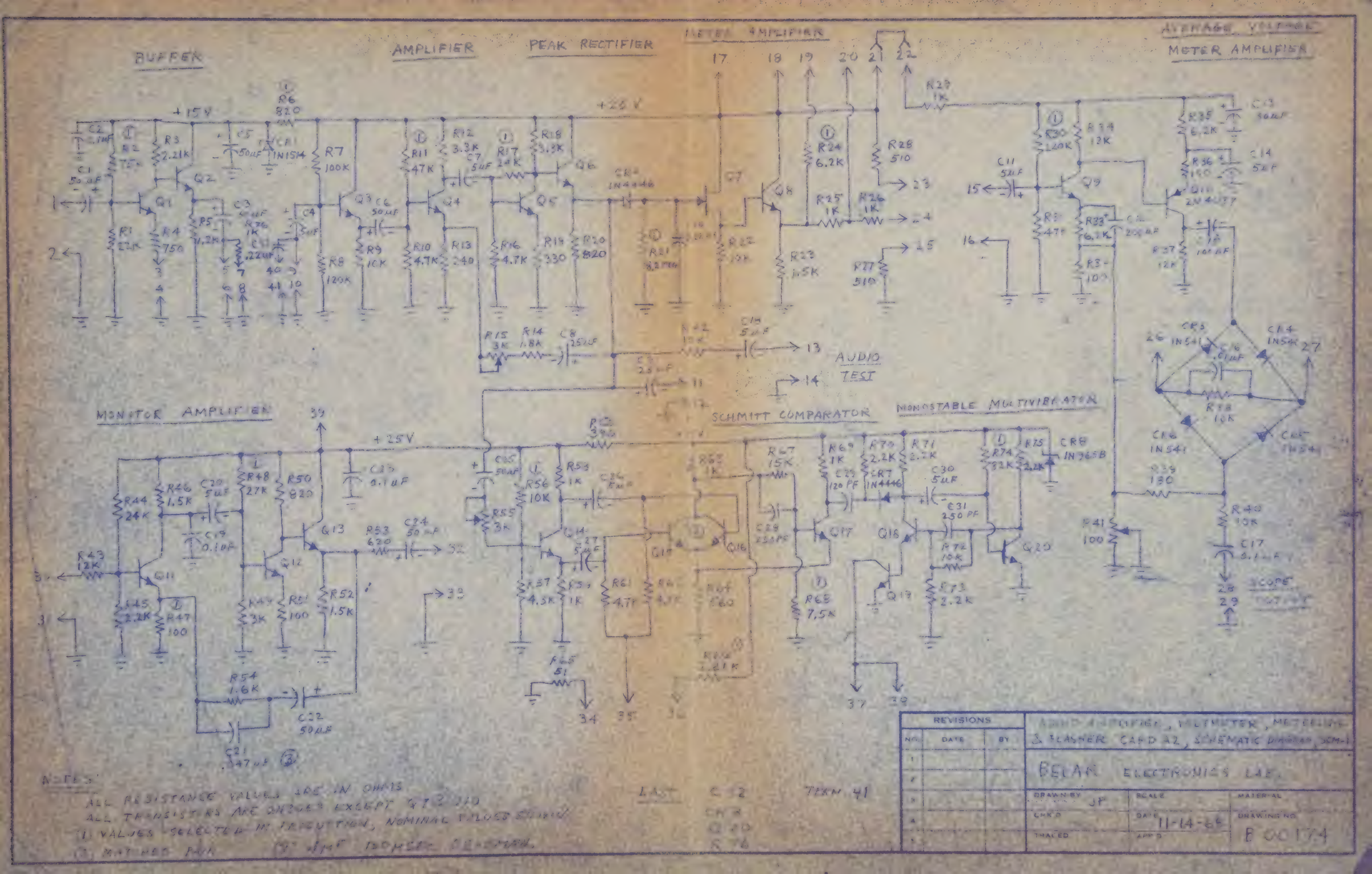
AUDIO AMPLIFIER, VOLTMETER, METERING & FLASHER CARD A2, SCHEMATIC DIAGRAM, SEM-1

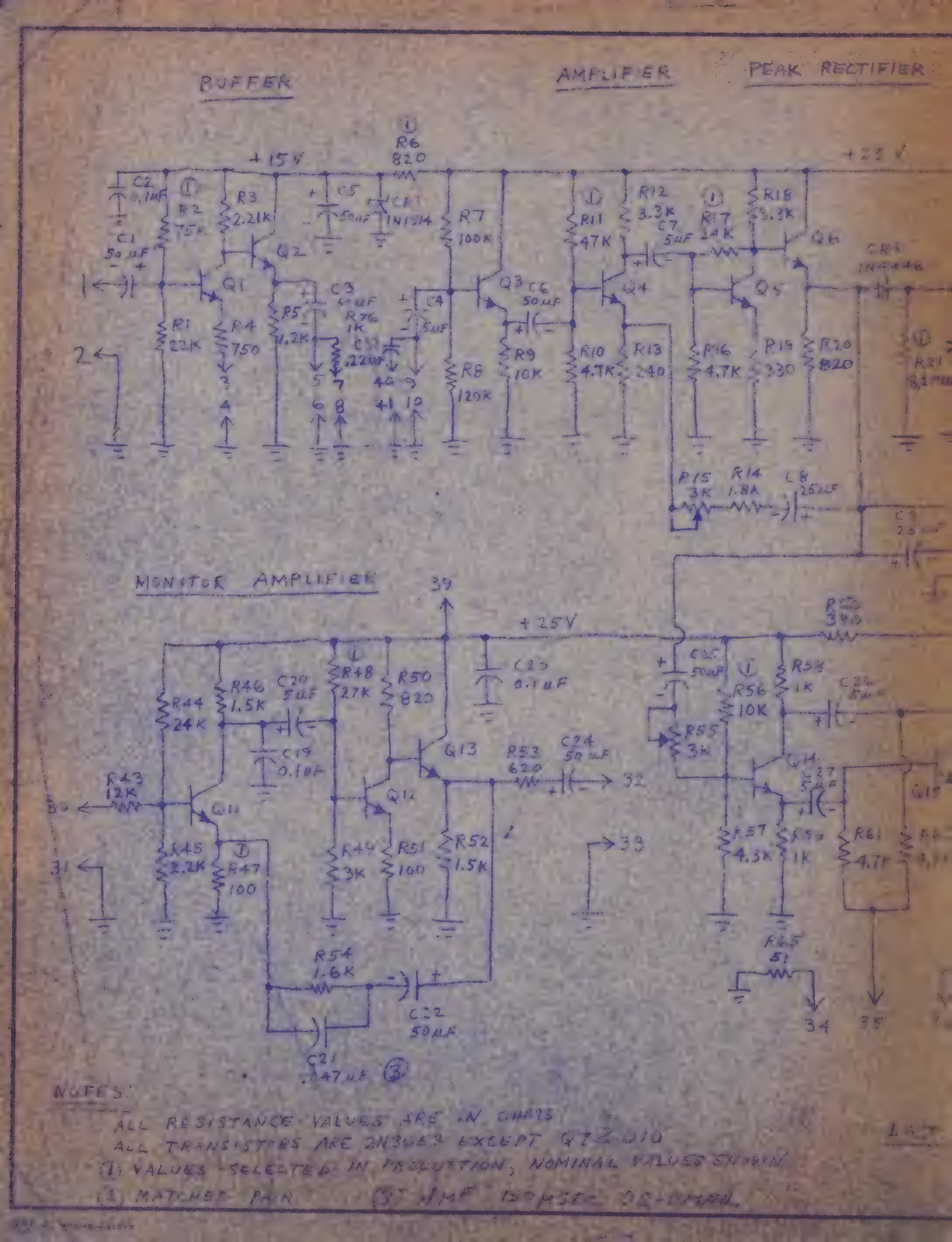
BELAR ELECTRONICS LAB.

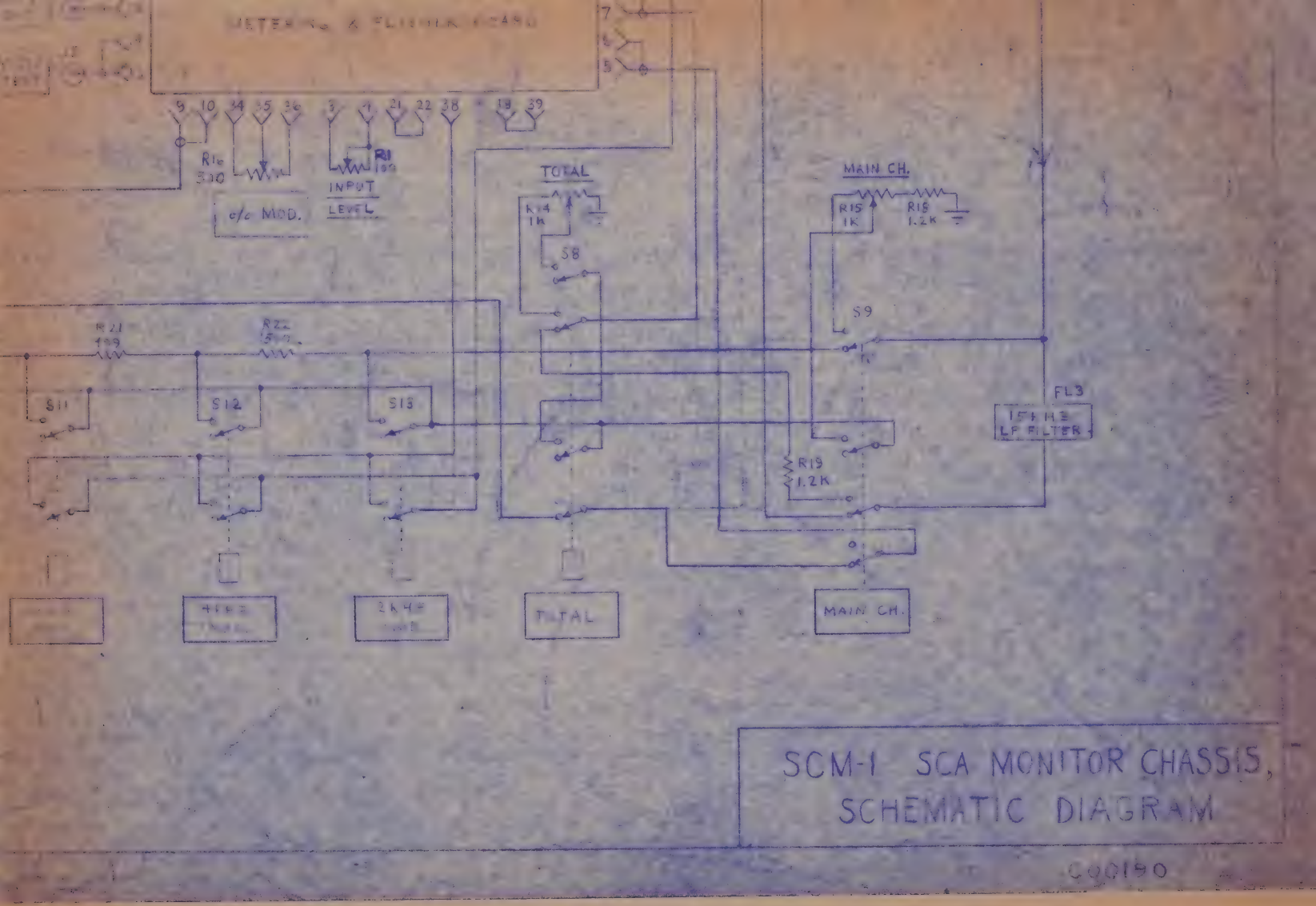
DRAWN BY	JP	SCALE	MATERIAL
CHK'D		DATE 11-14-68	DRAWING NO. B 00174
TRACED		APP'D	

C 32
CR 8
Q 20
R 76

TERM 41

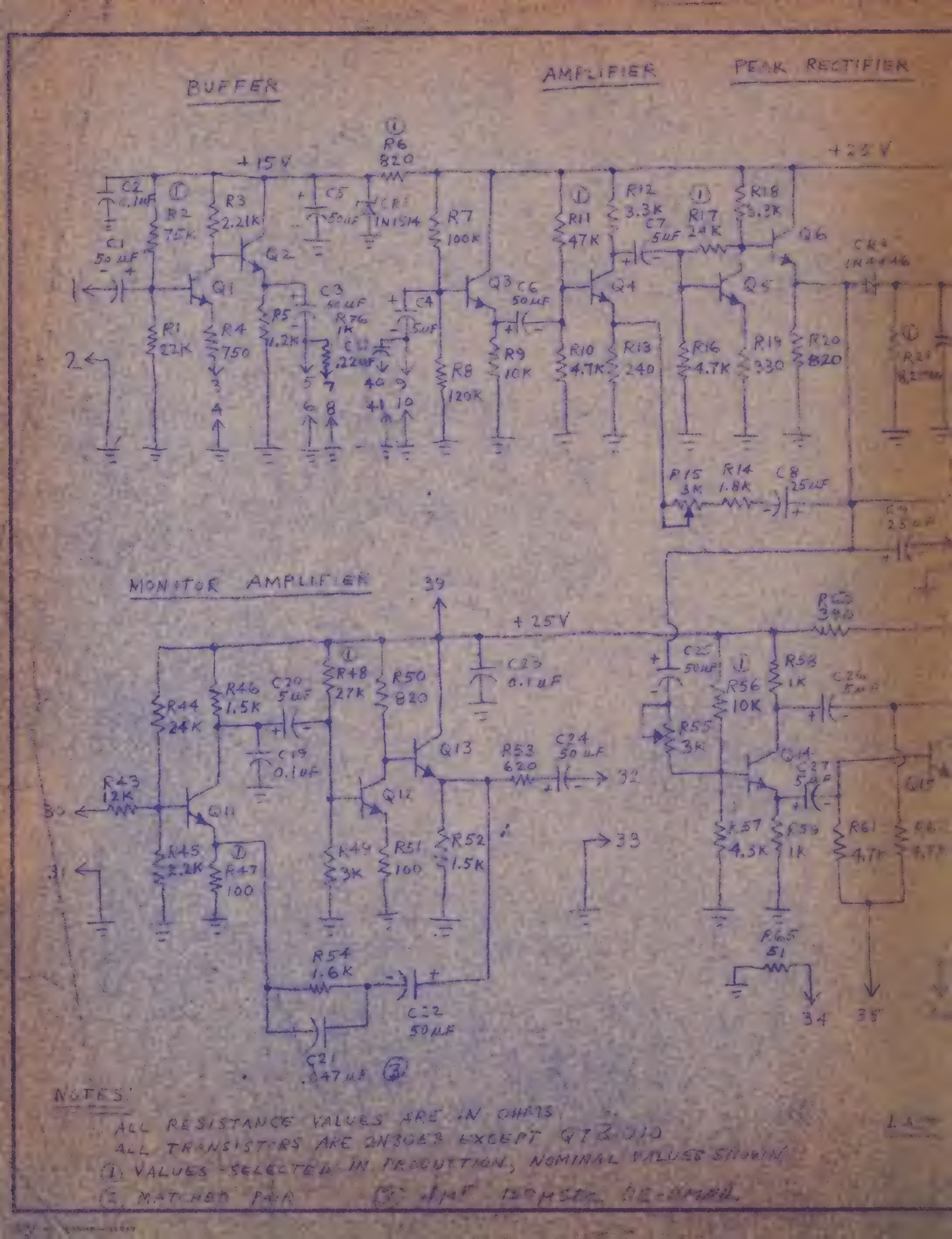

BUFFER
AMPLIFIER
PEAK RECTIFIER
METER AMPLIFIER
AVERAGE VOLTMETER
METER AMPLIFIER
+15V
+25V
+25V
MONITOR AMPLIFIER
SCHMITT COMPARATOR
MONOSTABLE MULTIVIBRATOR
AUDIO TEST
SCOPE OUTPUT
C1 50 uF
C2 .1uF
R1 22K
R2 75K
R3 2.21K
R4 750
P5 1.2K
C3 2uF
C4 5uF
C5 50uF
CR1 1N1514
R6 820
R7 100K
R8 120K
C6 50uF
R9 10K
Q1
Q2
Q3
R10 4.7K
R11 47K
R12 3.3K
R13 240
C7 5uF
R16 4.7K
R17 24K
R18 3.3K
R19 330
R20 820
Q4
Q5
Q6
CR2 IN4446
R21 3.32K
R22 10K
R23 1.5K
R24 6.2K
R25 1K
R26 1K
R27 510
R28 510
R29 1K
Q7
Q8
R30 120K
R31 47K
R32 12K
R33 6.2K
C10 200 uF
C11 5uF
Q9
Q10 2N4037
R35 6.2K
R36 150
C13 50uF
C14 5uF
R37 12K
C12 10 uF
R15 3K
R14 1.8K
C8 25uF
C9 2.5uF
R42 10K
C15 5uF
R12
CR3 IN541
CR4 IN541
CR5 IN541
CR6 IN541
C16 .01uF
R38 10K
R39 130
R40 10K
C17 .1uF
R41 100
R44 24K
R46 1.5K
C20 5uF
C19 .1uF
R43 12K
R45 2.2K
R47 100
R48 27K
R49 3K
R50 820
R51 100
R52 1.5K
Q11
Q12
Q13
R53 620
C24 50 uF
C25 .1uF
R54 1.6K
C22 50uF
C21 .047uF
R55 3K
R56 10K
R57 4.3K
R58 1K
C26
C27 5uF
R59 1K
R60 560
R61 4.7K
R62 4.7K
R63 51
R64 2.21K
Q14
Q15
Q16
Q17
Q18
Q19
Q20
R65 7.5K
R66 15K
R67 1K
C28 250 PF
C29 120 PF
CR7 IN4446
R69 1K
R70 2.2K
R71 2.2K
C30 5uF
C31 250 PF
R72 10K
R73 2.2K
R74 82K
R75 2.2K
CR8 IN3658
CR9 IN541
CR10 IN541
R76 390
R77 1K
R78 10K
C32
C33
C34
C35
C36
C37
C38
C39
C40
C41
C42
C43
C44
C45
C46
C47
C48
C49
C50
C51
C52
C53
C54
C55
C56
C57
C58
C59
C60
C61
C62
C63
C64
C65
C66
C67
C68
C69
C70
C71

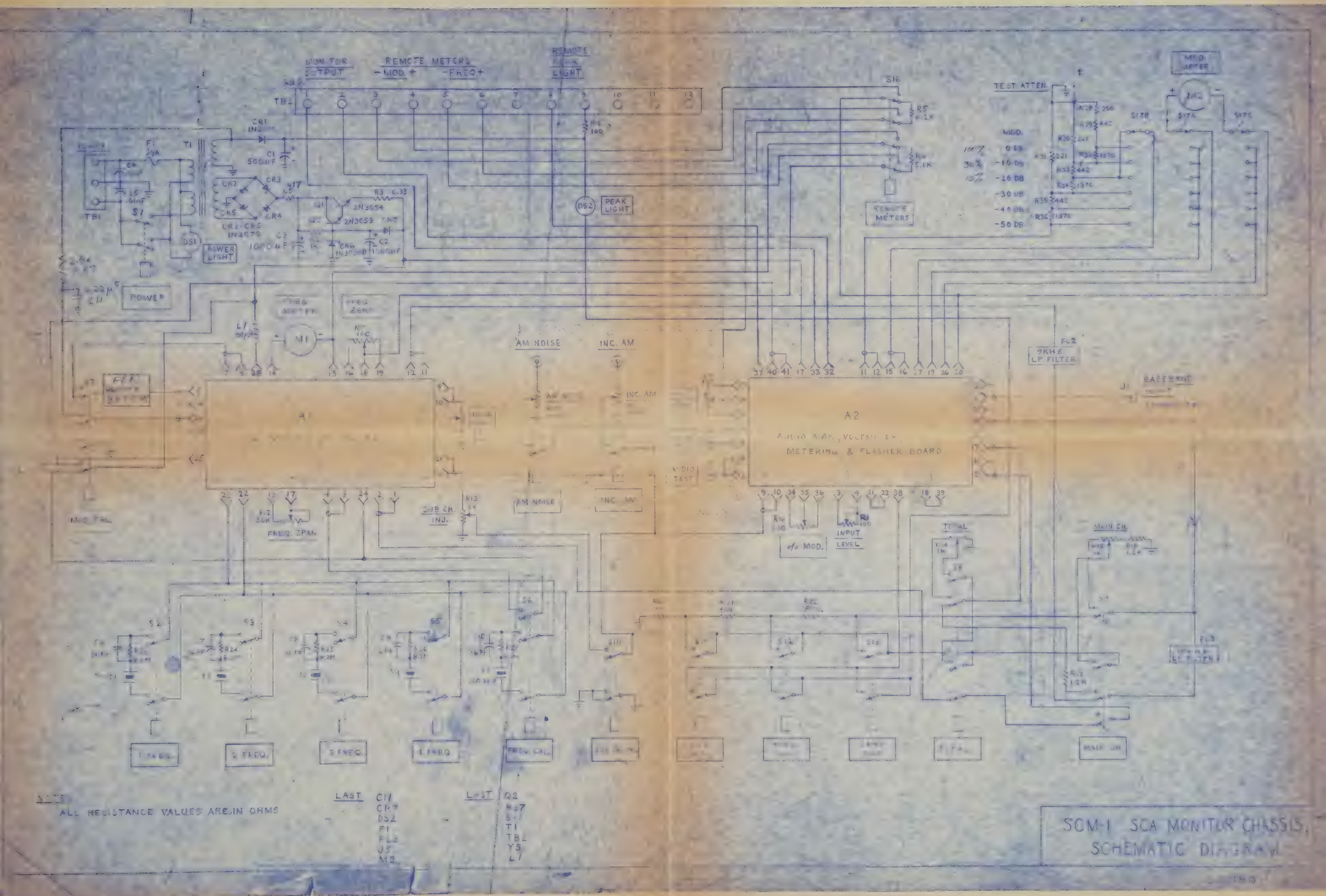

BUFFER
AMPLIFIER
PEAK RECTIFIER
+15V
+25V
MONITOR AMPLIFIER
NOTES:
ALL RESISTANCE VALUES ARE IN OHMS
ALL TRANSISTORS ARE 2N3063 EXCEPT Q12 Q10
(1) VALUES SELECTED IN PRODUCTION, NOMINAL VALUES SHOWN
(2) MATCHED PAIR
(3) .1MF DISPOSC DISC CERAM.



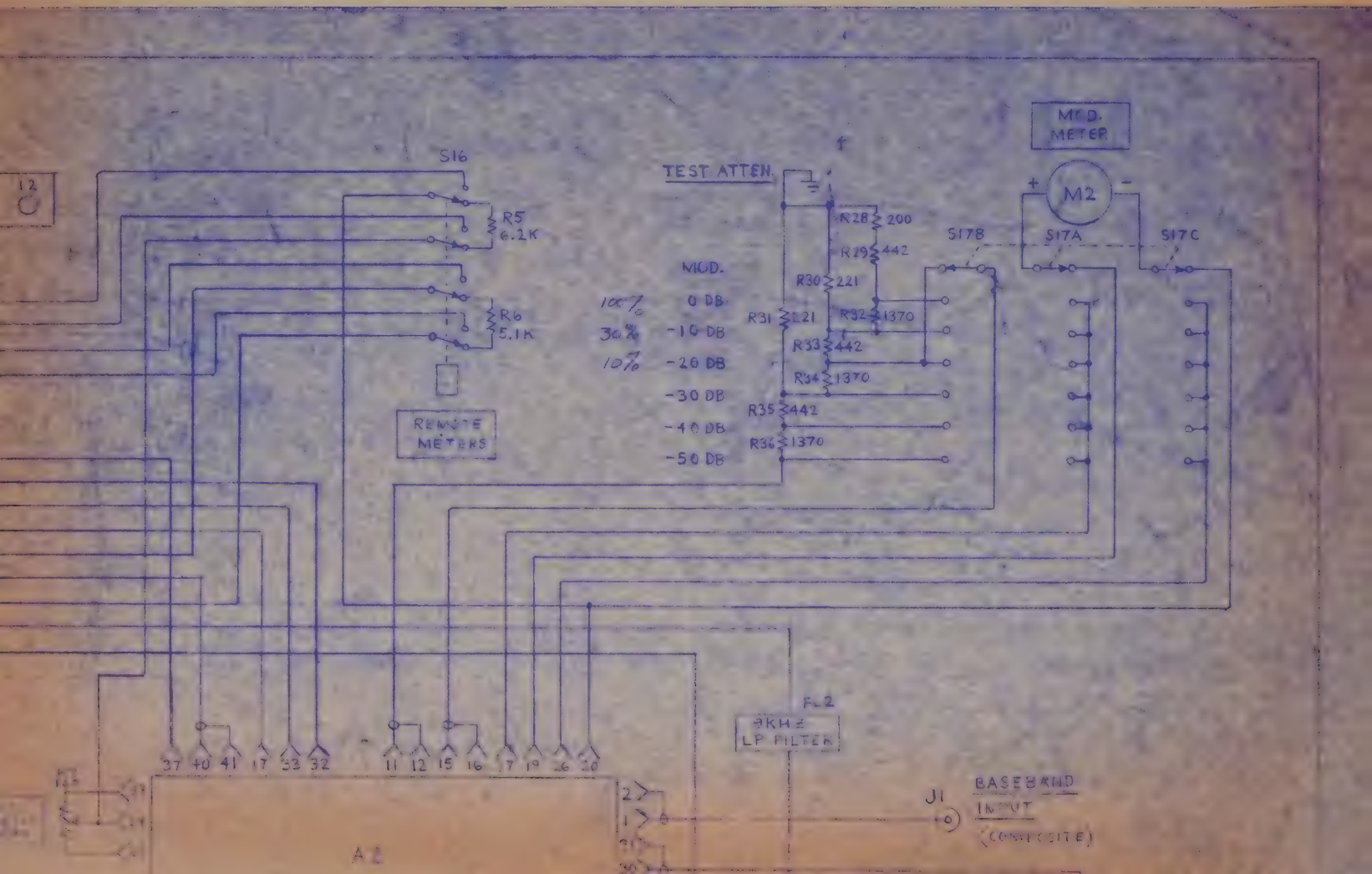
SCM-1 SCA MONITOR CHASSIS, SCHEMATIC DIAGRAM

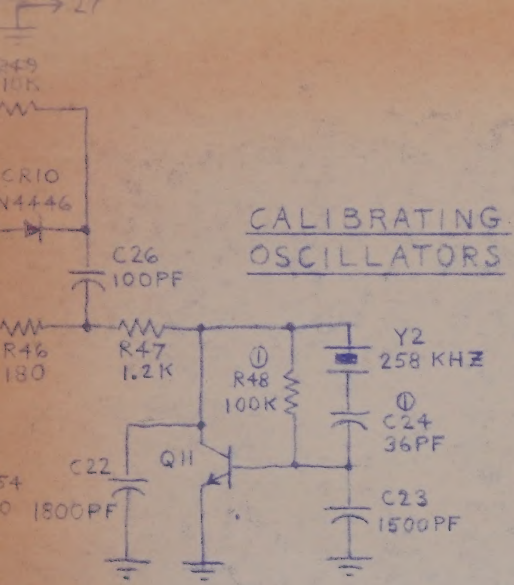
C00190


BUFFER
AMPLIFIER
PEAK RECTIFIER
MONITOR AMPLIFIER
+15V
+25V
+25V
39
R6 820
C2 .1uF
C1 50 uF
R2 75K
R3 2.21K
Q2
Q1
C5 50uF
CR1 1N1514
R7 100K
Q3
C6 50uF
R11 47K
R12 3.3K
R17 24K
C7 5uF
R18 3.3K
Q6
Q4
Q5
CR2 IN4446
R1 22K
R4 750
R5 11.2K
C3 50uF
R76 1K
C11 .22uF
C4 5uF
R8 120K
R9 10K
R10 4.7K
R13 240
R16 4.7K
R19 330
R20 820
R21 8.2K
R15 3K
R14 1.8K
C8 25uF
C9 25uF
R22 390
C25 50uF
R58 1K
R56 10K
C26 5uF
R55 3K
Q14
C27 5uF
Q15
R44 24K
R46 1.5K
C20 5uF
C19 0.1uF
R48 27K
R50 820
C23 0.1uF
Q13
R53 620
C24 50uF
R43 12K
Q11
Q12
R45 2.2K
R47 100
R49 3K
R51 100
R52 1.5K
R57 4.3K
R59 1K
R61 4.7K
R60 4.7K
R65 51
R54 1.6K
C22 50uF
C21 .047uF
30
31
32
33
34
35
NOTES:
1. ALL RESISTANCE VALUES ARE IN OHMS.
ALL TRANSISTORS ARE 2N3643 EXCEPT Q12,Q13
(1) VALUES SELECTED IN PRODUCTION, NOMINAL VALUES SHOWN
(2) MATCHED PAIR
(3) 4 pF 150 MSEC RE-SWEEP.



SCM-1 SCA MONITOR CHASSIS, SCHEMATIC DIAGRAM


S16
R5
6.2K
R6
5.1K
REMOTE METERS
TEST ATTEN.
MOD.
100%
0 DB
30%
-10 DB
10%
-20 DB
-30 DB
-40 DB
-50 DB
R28 200
R29 442
R30 221
R31 221
R32 1370
R33 442
R34 1370
R35 442
R36 1370
MOD. METER
M2
+
-
S17B
S17A
S17C
FL2
9KHz LP FILTER
J1
BASEBAND INPUT
(COMPOSITE)
A2
37 40 41 17 33 32
11 12 15 16 17 19 26 30

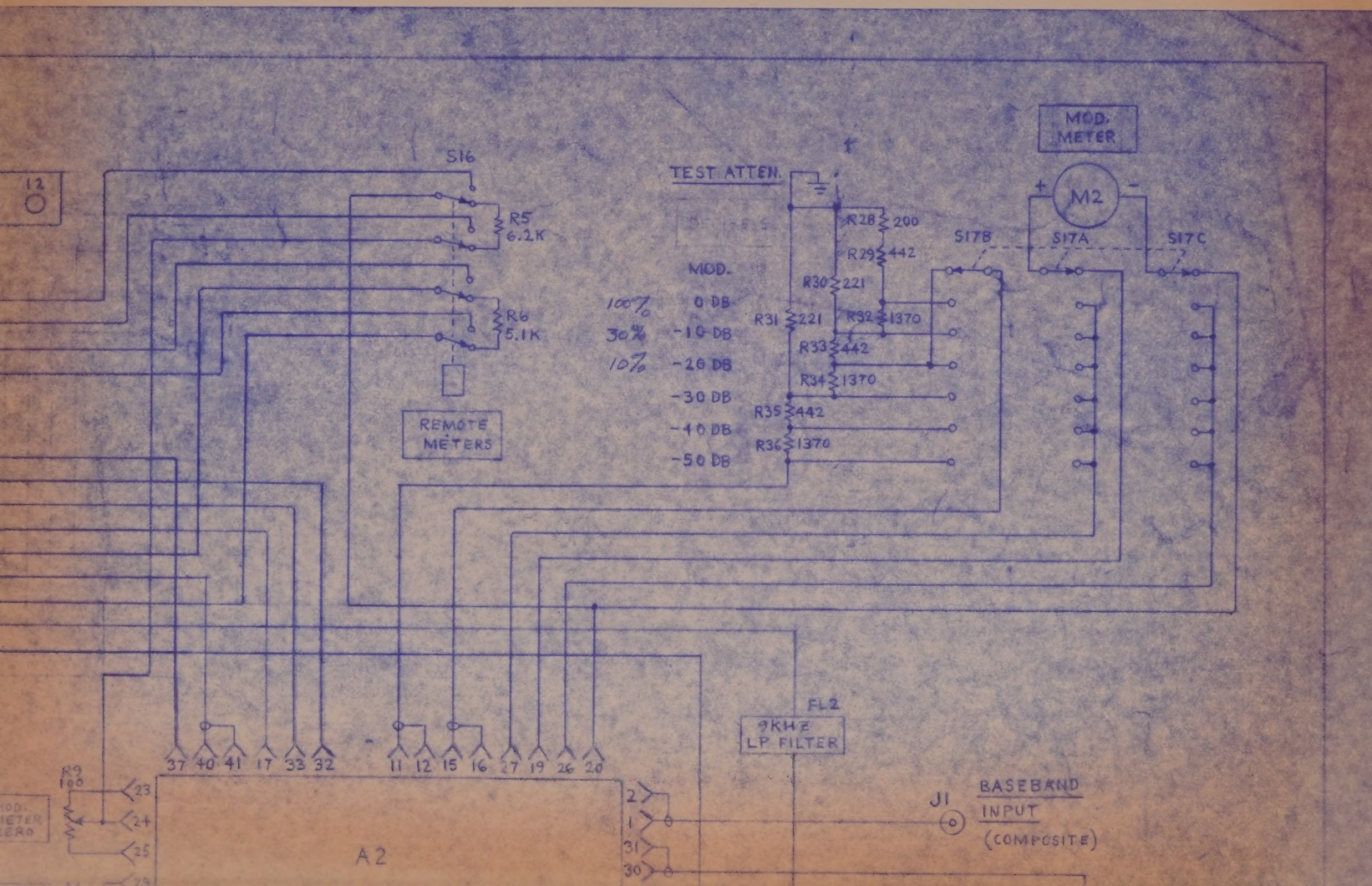


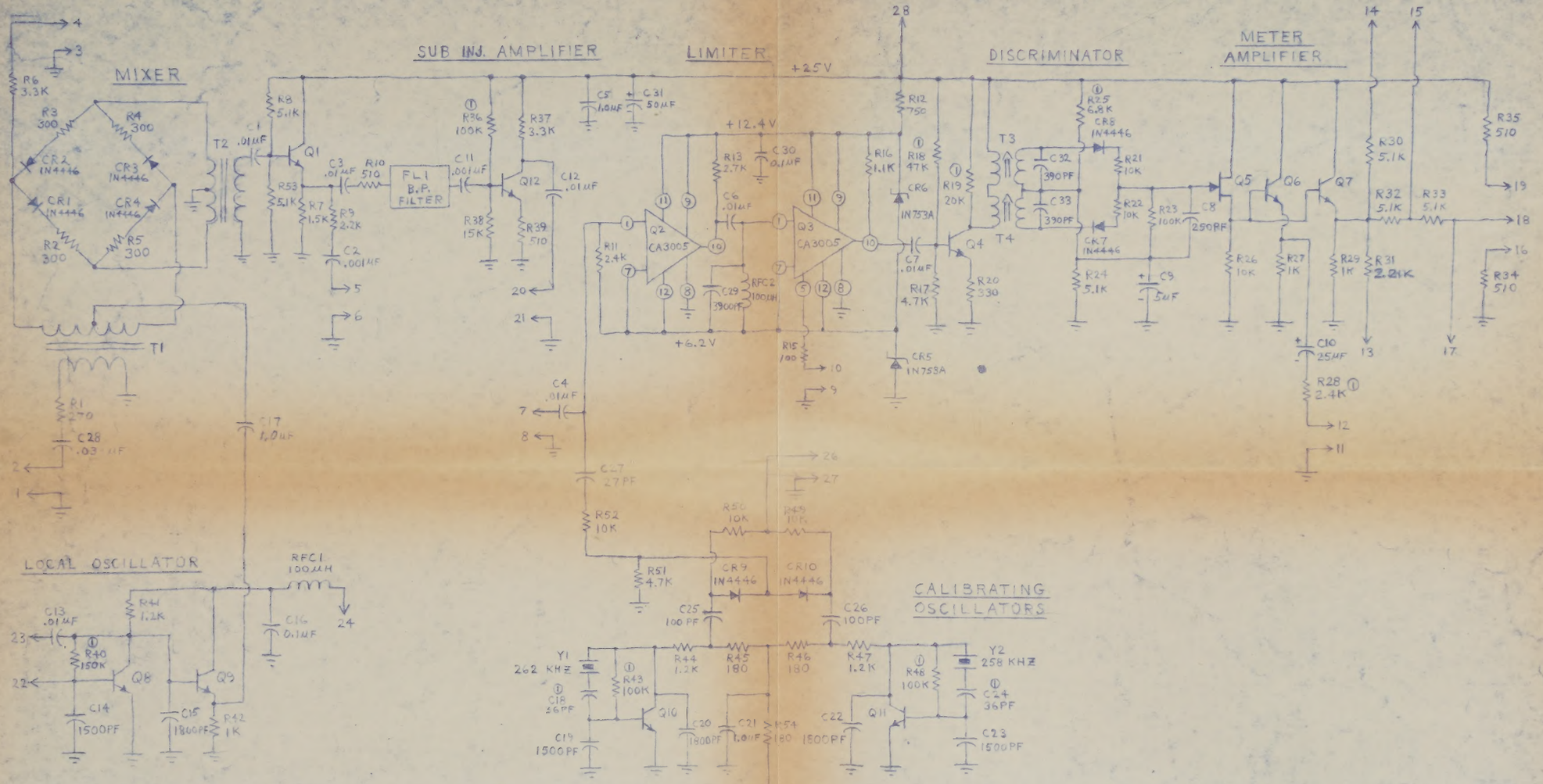
REVISIONS		
NO.	DATE	BY
1		
2		
3		
4		
5		

OSCILLATOR, MIXER & IF CARD A1,
SCHEMATIC DIAGRAM, SCM-1

BELAR ELECTRONICS LAB.

DRAWN BY JP	SCALE	MATERIAL
CHK'D	DATE 1-22-69	DRAWING NO. C00189
TRACED	APP'D	


S16
R5
6.2K
R6
5.1K
REMOTE
METERS
TEST ATTEN.
MOD.
100%
30%
10%
0 DB
-10 DB
-20 DB
-30 DB
-40 DB
-50 DB
R28 200
R29 442
R30 221
R31 221
R32 1370
R33 442
R34 1370
R35 442
R36 1370
MOD.
METER
M2
+
-
S17B
S17A
S17C
FL2
9KHZ
LP FILTER
37 40 41 17 33 32
11 12 15 16 27 19 26 20
R3
100
23
24
25
A2
2
1
31
30
J1
BASEBAND
INPUT
(COMPOSITE)



NOTES:

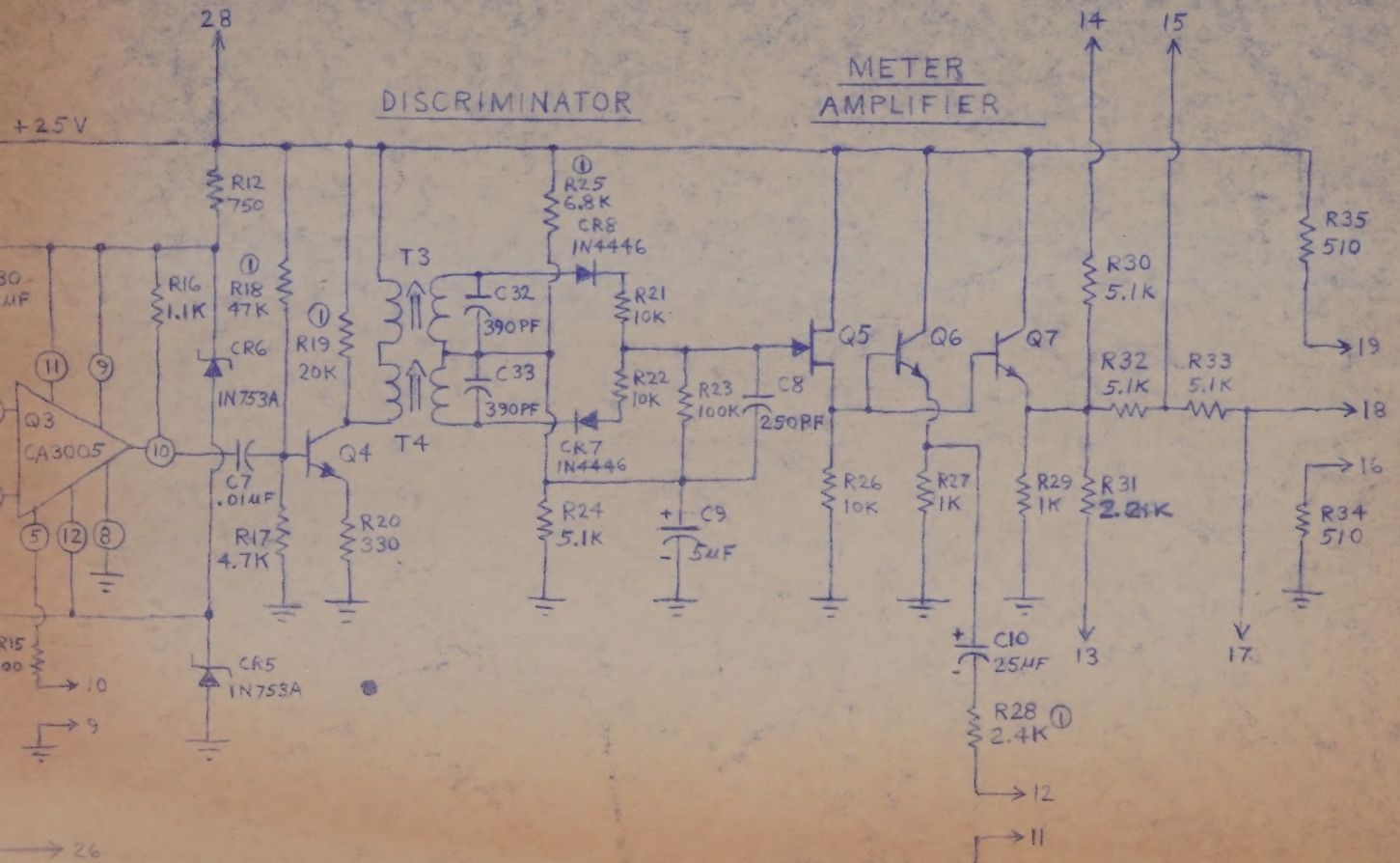
ALL RESISTANCE VALUES ARE IN OHMS.

ALL TRANSISTORS ARE 2N3053 EXCEPT Q2, Q3 & Q5.

① VALUES SELECTED IN PRODUCTION, NOMINAL VALUES SHOWN.

LAST C 38
CR10
FL1
Q12
R 54
RFC 2
T4
Y2
TERMINAL 28

REVISIONS			OSCILLATOR, MIXER & IF CARD A1, SCHEMATIC DIAGRAM, SCM-1		
NO.	DATE	BY	BELAR ELECTRONICS LAB.		
1			DRAWN BY JP	SCALE	MATERIAL
2			CHK'D	DATE 1-22-69	DRAWING NO C00189
3			TRACED	APP'D	
4					
5					


28
+25V
DISCRIMINATOR
METER
AMPLIFIER
14
15
R12
750
R16
1.1K
R18
47K
R19
20K
CR6
IN753A
T3
T4
C32
390PF
C33
390PF
R25
6.8K
CR8
IN4446
R21
10K
R22
10K
CR7
IN4446
R23
100K
C8
250PF
Q5
Q6
Q7
R30
5.1K
R32
5.1K
R33
5.1K
R35
510
19
18
16
R34
510
Q3
CA3005
C7
.01μF
Q4
R17
4.7K
R20
330
R24
5.1K
C9
5μF
R26
10K
R27
1K
R29
1K
R31
2.2K
C10
25μF
13
17
R28
2.4K
12
11
CR5
IN753A
10
9
26